U.S. Defense Research and Engineering

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December 3, 2003

Research & Engineering Goals

- **Integrate DoD S&T and Focus on Transformation**

- **Enhance Technology Transition**

- **Expand Outreach to Combatant Commands and Intelligence Community**

- **Accelerate Support to the War on Terrorism**

- **Address S&E Workforce**

A Definition of Transformation

"The Evolution and Deployment of Combat Capabilities
That Provide Revolutionary or Asymmetric
Advantages to Our Forces"

- Quadrennial Defense Review
Sep 30, 2001

The World Has Changed

Cold War — Threat of Superpower Conflict

- **Focused Science & Technology (S&T) and Acquisition programs to counter the Soviet threat**
- **Fewer, better understood challenges**
- **Fewer military-specific technologies**
- **More predictable threats and locations of conflict**

Today — Threat of Terrorism

- **Numerous adversaries with wide range of objectives and capabilities**
- **Requirement to invest in numerous S&T programs/ military systems**
- **Large commercial investment in S&T leverage dual-use adaptive technologies**
- **Large commercial S&T base available to adversaries**
- **More uncertain National Security environment**

# Quadrennial Defense Review
Critical Operational Goals

- **Critical Transformational Capabilities**
  - **Protect Bases of Operations**
  - **Conduct Information Operations**
  - **Project and Sustain US Forces**
  - **Deny Enemy Sanctuary**
  - **Conduct Space Operations**
  - **Leverage Information Technologies**
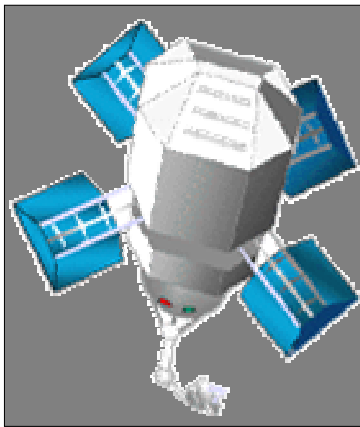
Protect Bases of Operations

- *Combating Terrorism*

- *Chemical/Biological Defense*

- *Missile Defense*

- *Consequence Management*
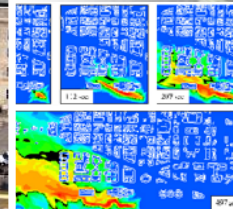
Conduct Information Operations

- *Defensive IO and Information Assurance*

- *Offensive IO*

Project and Sustain US Forces

- *Anti-Access Capabilities*

- *Minimize Logistics Footprint*

- *Rapid Force Deployment*
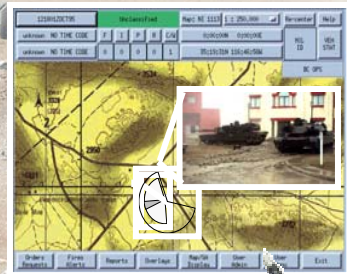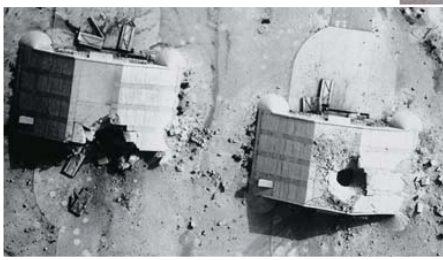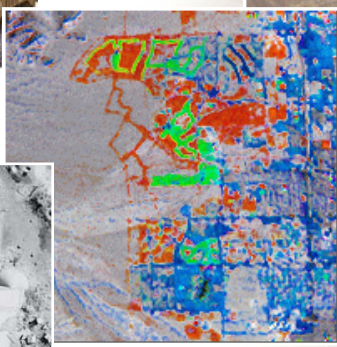
- *Warfighter Readiness*

Deny Enemy Sanctuary

Persistent Surveillance, Tracking and Rapid Engagement with Precision Strike

- *Remote Sensing/Enhanced C4ISR*

- *Unmanned Aerial Vehicle*

- *Long-Range Precision Strike*

- *Small-Diameter Munitions*

- *Defeat Hard and Deeply Buried Targets*

- *Deep Mobile Attack*
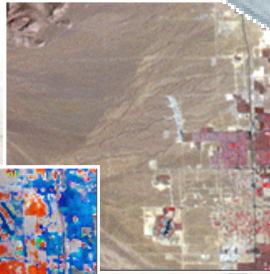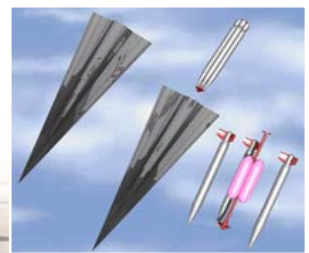
Conduct Space Operations

- *Ensure Access to Space*

- *Protect Space Assets*

- *Assure Space Surveillance*

- *Control Space*

- *Sub-Orbital Space Vehicle*
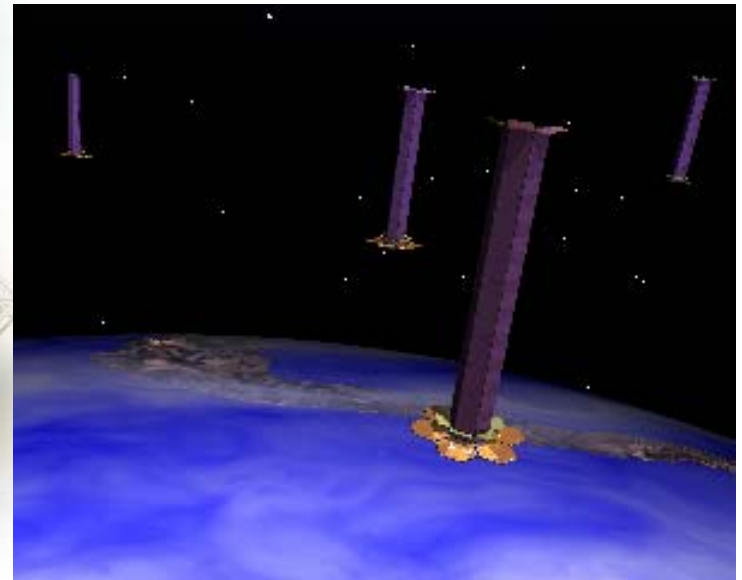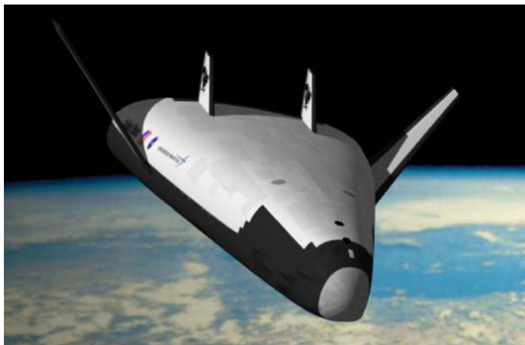
Leverage Information Technologies

- *High-capacity Interoperable Communications*

- *Survivable, Improved, Tactical and Strategic Communications*

- *End-to-end C4ISR*

Soil

Concrete Structure   Concrete Wall with Rebar   Detonation Cavity

New Process

Old

Integrated by Combat. Cdrs.

↑

Systems

↑

Requirements

↑ ↑ ↑ ↑

Bottom up, stovepiped

Systems Driven

New

Strategic Policy Guidance

⇓

**Joint Operating Concepts
Joint Functional Concepts
Integrated Architectures**

⇓

Service Operating Concepts/Capabilities

⇓
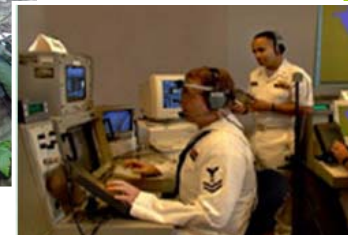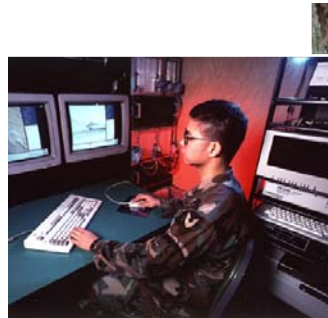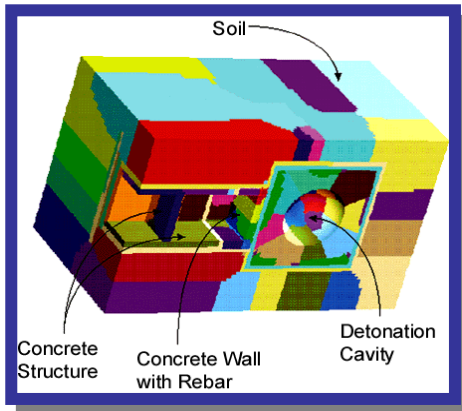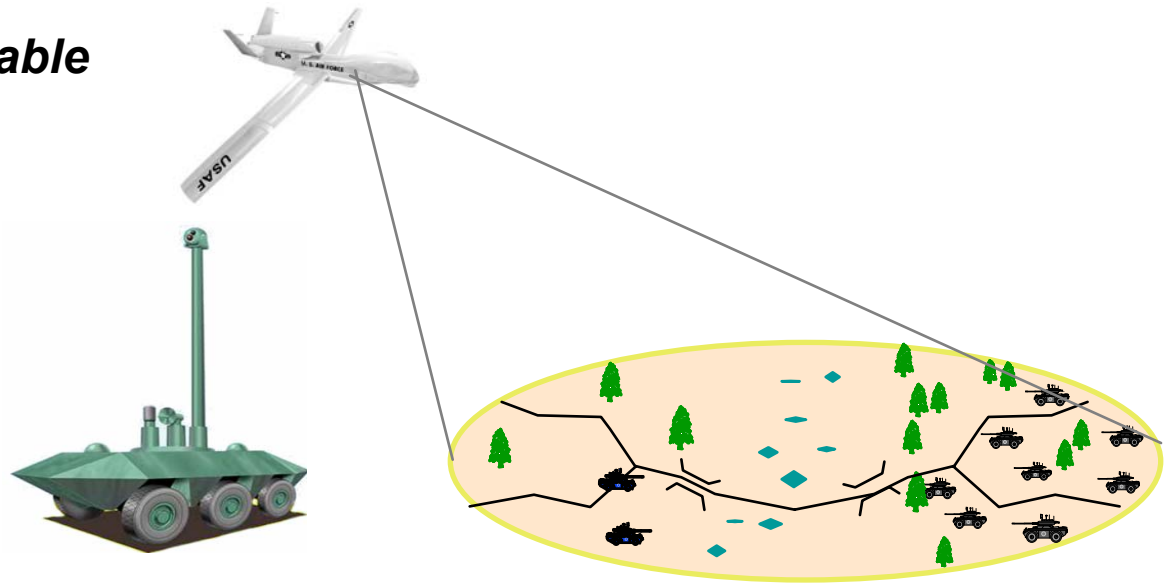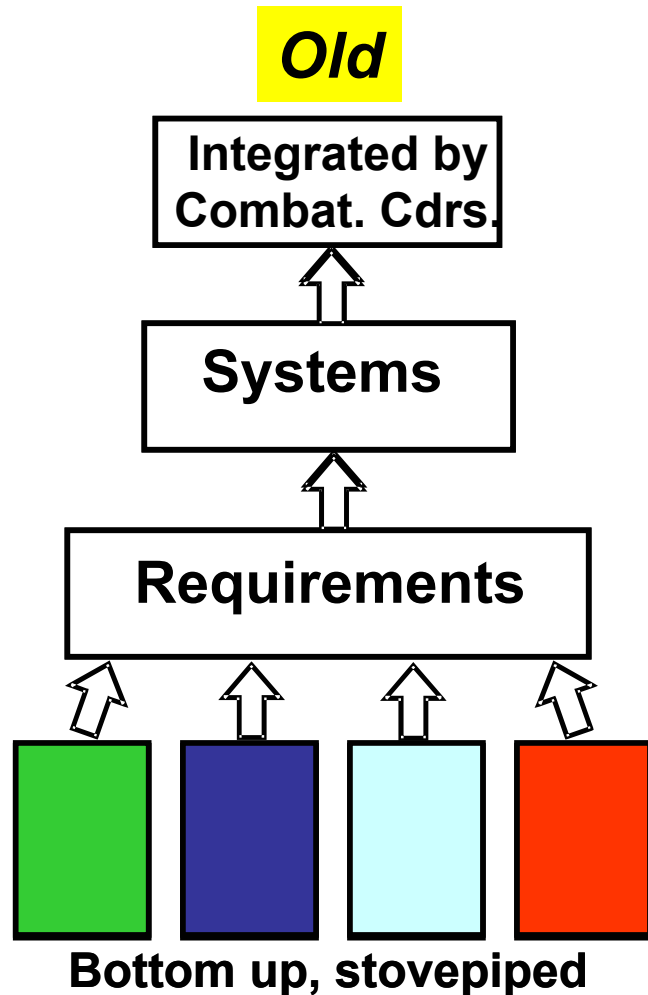
Joint Capabilities
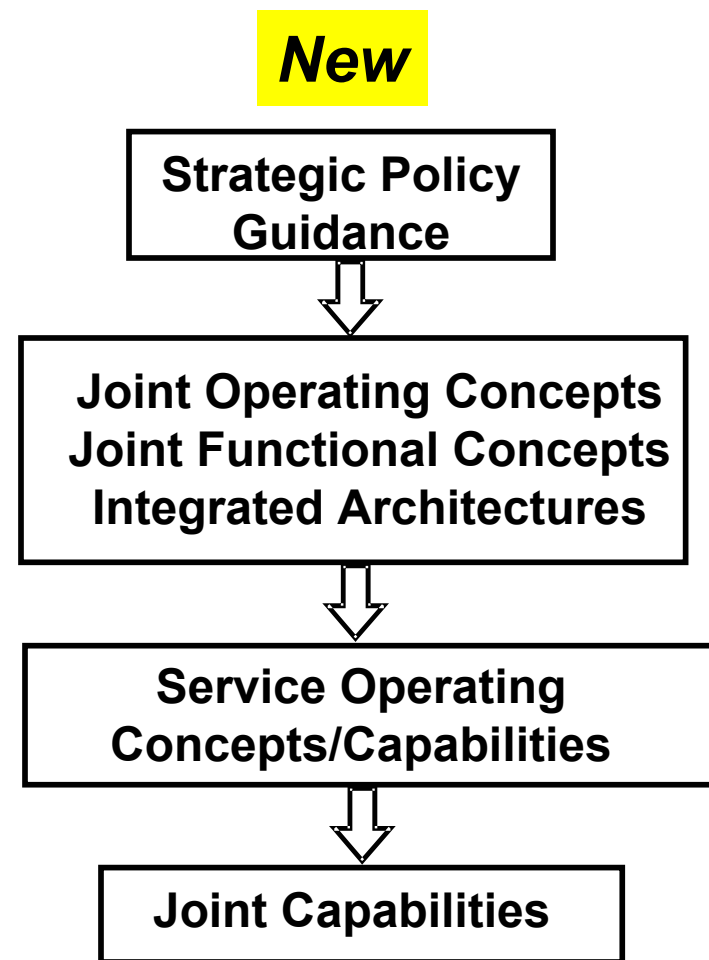
Capabilities Driven

Integrated Annual Defense S&T Planning Process

Quadrennial Defense Review

CJCS Joint Functional Concepts

Near-Term S&T

Defense S&T Strategy

T A R A * REVIEW

Budget & POM

Basic Research Plan

Defense Technology Area Plan

Joint Warfighting S&T Plan

Service/Agency S&T Plans
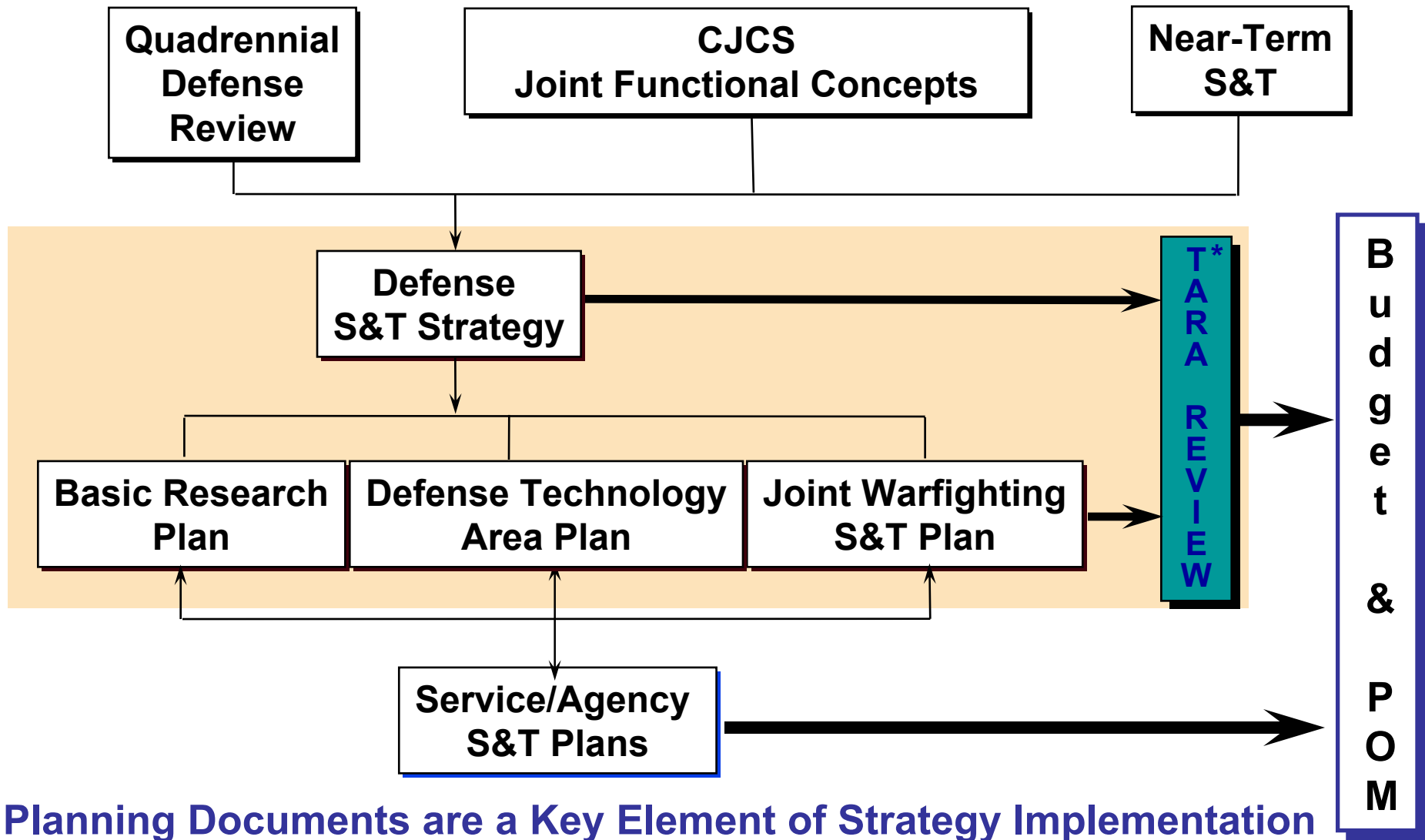
Planning Documents are a Key Element of Strategy Implementation

S&T Strategy and Plans

Joint Warfighting
Science and Technology Plan
February 2003

Published by
Department of Defense
Director, Defense Research & Engineering
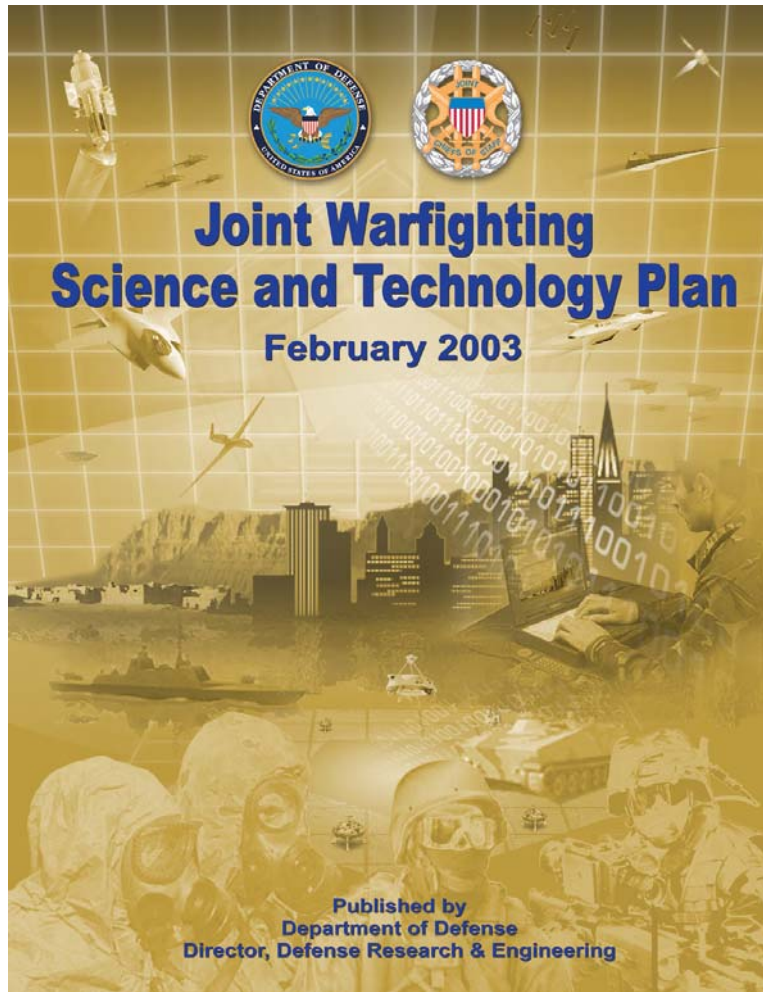
Defense Science and Technology Strategy and Plans

- *Defense Research and Engineering Strategy (Being Updated)*

- *Basic Research Plan (6.1) - BRP - (Biennial)*

- *Defense Technology Area Plan (6.2, 6.3) - DTAP - (Biennial)*

- *Joint Warfighting Science and Technology Plan - JWSTP (*Annual)*

- *Defense Technology Objectives (DTO) Volume that supports JWSTP and DTAP (Annual)*

Basic Research Plan (BRP)

BRP-- A strategic plan to link longer term research to broad, revolutionary warfighter capabilities

- **Basic Research Areas**
  - Physics
  - Chemistry
  - Mathematics and Computer Science
  - Electronics
  - Materials Science
  - Mechanics
  - Terrestrial and Ocean Sciences
  - Atmospheric and Space Sciences
  - Biological Sciences
  - Cognitive and Neural Science

A Strategic plan guiding new technology development built around Basic Research Areas

Defense Technology Area Plan (DTAP)

- **DTAP -- A detailed plan focusing DoD science on militarily significant technologies in specific functional areas**

JSF

F/A-22

Example: DTO AP.08 Fighter/Attack Propulsion

An agreement between the S&T Community and Acquisition Customers

Joint Warfighting S&T Plan (JWSTP)

JWSTP-- Focus to blend emerging technology into warfighter needs

Enhanced Situational Awareness for Individuals/Leaders in MOUT

Improved Squad Radio Effective in MOUT

Combat ID System - Effective in buildings

Increased Lethality/ Wpns Capabilities for MOUT

Improved All Environment Optics (Day, Night, I2, Thermal, etc...)

Non Lethal Munitions

Remote Intel Collection Capability for Battalion & below

Precise Position Location inside of buildings

"Thru-wall" scanning capability for MOUT Squad Leader

Improved MOUT Individual Mobility Tools

Physical Protection Kit (Eyes, Joints, Medical, Hearing, etc...)

"Real time" Intel Down-link to Map Products

An agreement between Joint Warfighters and S&T Community

Example: DTO E.02 *Military Operations in Urban Terrain*

Objective: Demonstrate a situation awareness/communications/ geolocation capability in restrictive environments.

Near-Term S&T Operator Involvement

All Services are evolving their technology development and acquisition processes to a "systems approach"

FROM

S&T

Acq

TO

S&T   **Acq**
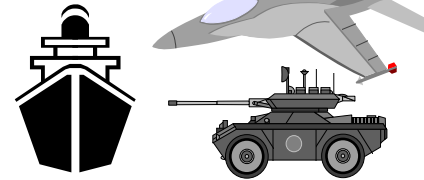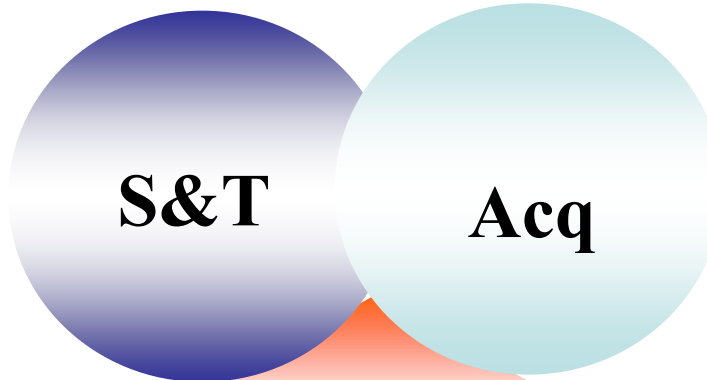
Operational Capabilities (Warfighter)

Right
- *Technology*
- *People*
- *Time*

Technology and Transformation

- **Transformation Attributes**

Knowledge

Agility   **Speed**

Lethality
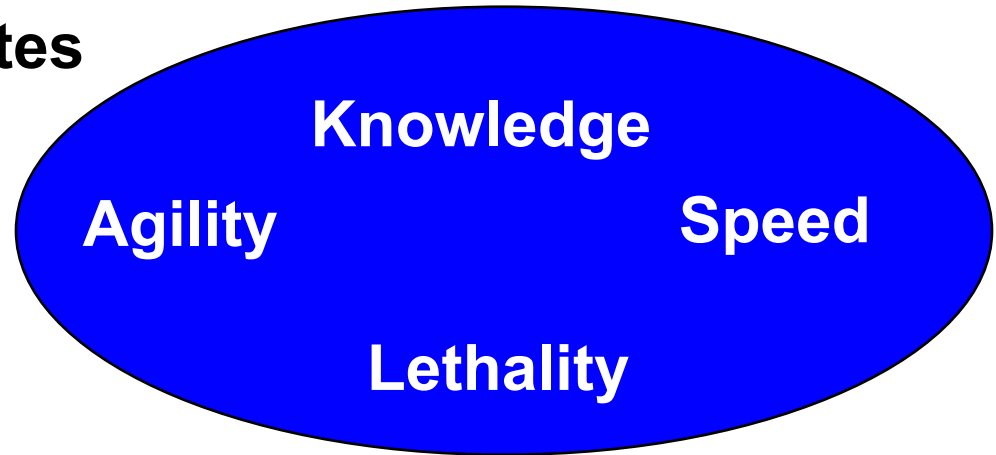
- **Three Cross-Cutting Transformation Projects**
  - o **National Aerospace Initiative**
  - o **Energy & Power Technologies**
  - o **Surveillance and Knowledge Systems**

What Technologies Bring About Tomorrow's Operational Advantage?
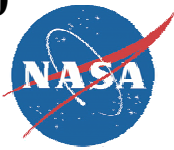
National Aerospace Initiative
-- *Technology Framework* --

NAI

- *Strategic Focus*
- *Technical Coordination*
- *Aerospace Workforce*

High Speed Hypersonics

TCT/NPR

Expendable (Missiles)

Reusable [Mach 0 - 12]

Mach<4

4<Mach<15

Long-Range Strike [Mach 0-7]

Space Access

DoD/NASA

Reusable Launch Vehicle

2nd Stage Rocket Engine

Air-Breathing 1st Stage (TSTO) [Mach 0 - 12]

Space Maneuvering Vehicle

Space Technology

Space Commission

Responsive Payloads

Flexible Comm

ISR

Space Control

Synergy Goal: 1 + 1 + 1 > 3

National Aerospace Initiative

Mach Number per Year to 2012

Legend:
- Production
- X-Vehicles
- NAI

Data labels on chart: X-15, SR-71, XB-70, Concorde, F-4, F-15, F-16, F-117, B-2, F-22

Callout boxes:
- Hydrogen Scramjet Mach 8-15
- Hydrocarbon Scramjet Mach 4-7
- Ramjet Mach 3-4
- High Speed Turbine Mach 2-4

Region labels: Space Access, Strike Aircraft, Missiles

X-axis (years): 1960, 1970, 1980, 1990, 2000, 2010, 2020
Y-axis (Mach Number): 0, 5, 10, 15, 25

Hypersonic Component Technology Development and Ground Demonstrations

NAI

Hypersonic *System* Technology Development and *Flight* Demonstrations

Energy and Power Technologies
-- *Enabling Electric Force* --

POWER GENERATION

- **Fuel Cells & Fuel Reforming**
- **Novel Power**

ENERGY STORAGE

- **Batteries**
- **Capacitors**

POWER MANAGEMENT & CONTROL

- **Switching & Conditioning**
- **Power Transmission & Distribution**
- **Thermal Management**

Electric Warship

FUEL CELL

More Electric Aircraft

Space Based Radar

Electric Warship

Power Needs

FY02   FY12

High Power Microwave

Warrior

Hybrid/Electric Combat Vehicle

Electric/Hybrid Weapons

New Operational Capabilities

Energy and Power Technologies

Power, Watts (y-axis)

- 1 G
- 10 M
- 100 K
- 1 K
- 10
- 0.1
- 0.001

Mission Length (x-axis): Sec, Min, Hrs, Days, Month, Years

X Directed Energy Weapons

X Ship DDX (Destroyer)

X Future Combat System, Mobility

X Satellites

X Home

X Cars

X Tools

X Warrior

X Laptops

X Cell Phones

X Cameras

X Watches

DoD Focus

Commercial Focus

Surveillance and Knowledge Systems (SKS) Initiative

Information and Decision Dominance achieved through integrated C4ISR technologies that enable seamless, interoperable, knowledge-based, and assured Joint & Coalition Network-Centric Operations & Warfare.

- *Sensing:*
Management and tasking of pervasive, persistent sensors for enhancing battlespace knowledge
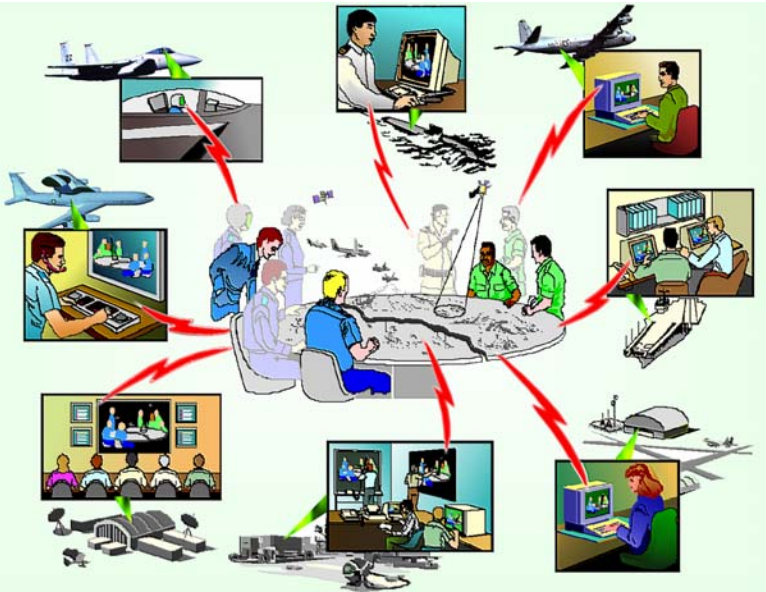
- *Comms & Networking:*
Guaranteed, 365x24x7, mobile, information access and delivery (always-on "internet dial tone")

- *Knowledge Management:*
Dramatically improved speed of command through integrated Common Picture, Collaboration, and Planning

- *Information Security (Cyber Ops):*
Network protection, information assurance; offensive disruption

Surveillance & Knowledge Systems

S&KS Initiative Technology Areas

Communications, Networking and Information Assurance

- **Transport Networks**

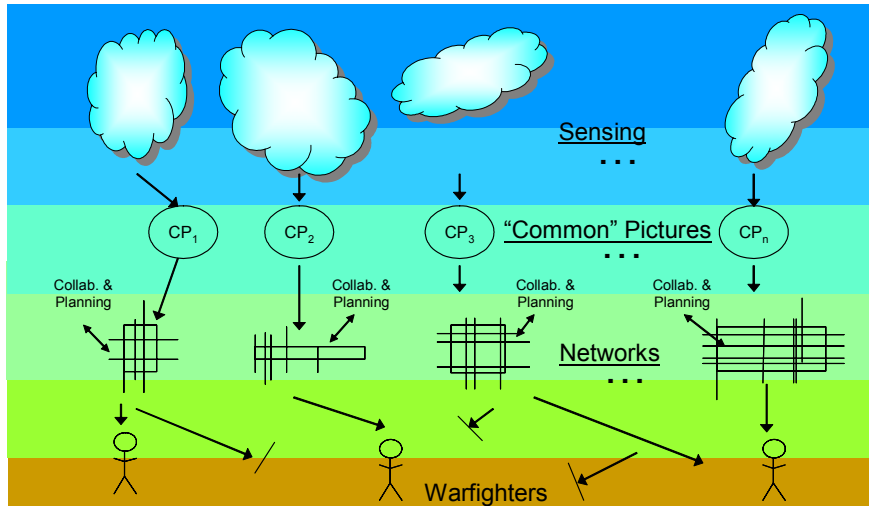- **Information Management and Distribution**

- **Information Assurance**

Sensing

- **Advanced Sensors**

- **Sensor Network Management**

- **Signal & Information Processing and Fusion**
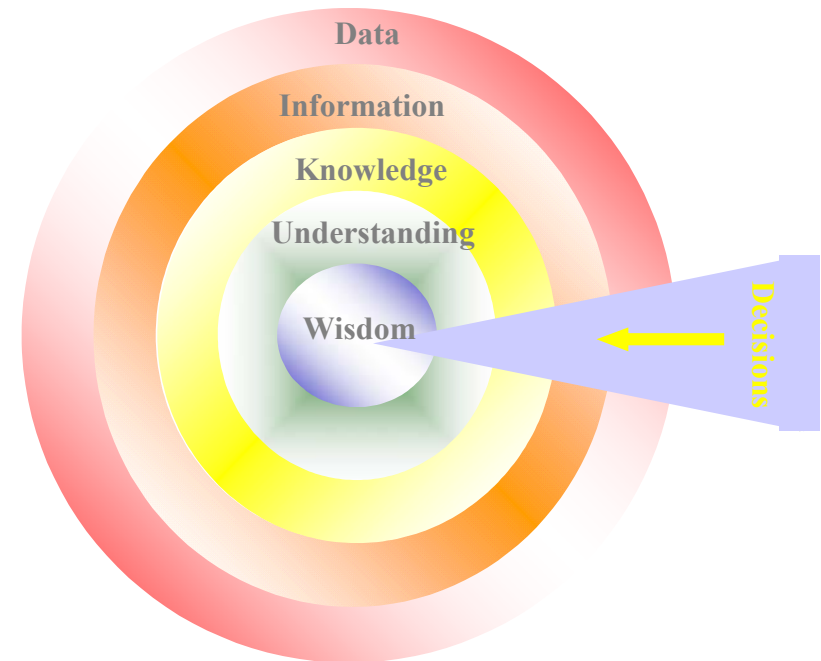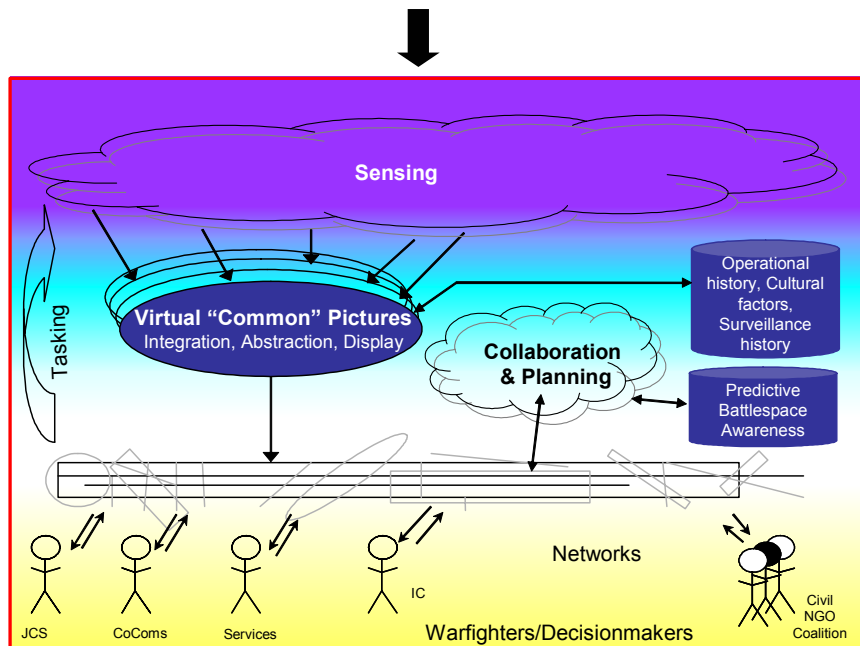
- **Autonomous Systems**

Knowledge Making

- **Decision-making**

- **Modeling and Simulation**

- **Computing and Software**

Surveillance and Knowledge Systems

Technology Foci
- **Adaptive Networks**
- **Ubiquitous Sensors**
- **Decision Aids**

DoD Combating Terrorism Technology Task Force (CTTTF)

- *Task Force Established by DDR&E - Sept 19, 2001*

- *Collaborative DoD Science & Technology (S&T) Organizations coordinating with:*
  - Joint Staff (J-3 / J-39, J-8, etc.)
  - Combatant Command (CoComs) – CENTCOM, SOCOM, etc.
  - Departments of Energy, Homeland Security, CIA, etc.

- *Objectives:*
  - Identify relevant DoD technologies with potential to support the Global War on Terrorism (GWOT)
  - Address & reexamine complex operational issues which are potentially amenable to S&T solutions
  - Rapidly transition, in coordination with Joint Staff & Military Services, S&T programs to address specific needs

NATO Research & Technology Organization (RTO)

- **Feb 2002: NATO RTO Combating Terrorism Workshop (hosted by DDR&E)**

  – **How NATO Defense R&T community could contribute to the war on terrorism**

  – **Defense Against Terrorism (DAT) R&T Board (RTB) Sub-Group**

    - **Chaired by Dr. John Hopps, DUSD(LABS)**

    - **Assess if RTO is working the right DAT topics**

    - **Determine level national support**

Summary

- **A robust, integrated, capabilities-based Science and Technology (S&T) program is vital to transforming the force**

- **Cross-Cutting Initiatives Established**

  - **National Aerospace Initiative**

  - **Surveillance and Knowledge Systems initiative**

  - **Energy & Power Technologies**

- **DoD S&T is "accelerating the transition of technology into operational capability"**

- **CTTTF identifies technology to measurably improve the nation's ability to combat terrorism across the spectrum from prevention to protection to response**

- **International Collaboration in S&T is critical**

Backup